IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:	§	
Paul James Broyles	§	Group Art Unit: Unassigned
	§	
Serial No.: 10/796,627	§	
	§	Examiner: Unassigned
Filed: March 9, 2004	§	
	§	
For: DYNAMIC ALLOCATION OF DEVICE	§	Atty. Docket: 200301870-2
TO HOST CONTROLLERS	§	Comp:0208-1/FLE/SWA

Mail Stop Petitions
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313

Sir:

PETITION UNDER 37 C.F.R. § 1.181 IN RESPONSE TO NOTICE OF OMITTED ITEM(S) IN A NONPROVISIONAL APPLICATION

In the Notice of Omitted Item(s) in a Nonprovisional Application mailed on January 24, 2005, the Patent Office indicated that page 7 of the specification was missing from the above-referenced application. Accordingly, the Patent Office outlined three options: (1) file a petition if Applicant contends that the missing item was in fact filed with the nonprovisional application papers; (2) file the missing item and accept its filing date as the filing date of the above-referenced application; or (3) take no action and accept the application without the missing item as indicated in the notice.

Applicant respectfully asserts that the entire specification, including page 7, was filed on March 9, 2004, and that the Patent Office has apparently misplaced page 7 of the specification. On March 9, 2004, Applicant filed a Request for a Continuing Application under 37 C.F.R. § 1.53(b), claiming priority to application Serial No. 09/791,288, filed on February 23, 2001. The papers filed on March 9, 2004, included: (1) a Request for a Continuing Application under 37 C.F.R. 1.53(b); (2) a copy of the prior application, including the drawings; (3) a copy of the prior Declaration under 37 C.F.R. § 1.63; (4) a copy of the Recorded Assignment from the parent application; (5) a Preliminary Amendment and

Remarks; (6) an Information Disclosure Statement, form PTO-1449, and a copy of other art cited in the PTO-1449; and (7) two return postcards listing each of the items filed on March 9, 2004.

The postcard evidencing receipt of all of these papers by the U.S. Patent and Trademark Office is attached as Exhibit 1. It should be noted that the returned postcard includes the PTO stamp evidencing that the above-referenced application was assigned Serial No. 10/796,627 and accorded a filing date of March 9, 2004. It should further be noted that the postcard lists all of the items mentioned above, including a copy of the parent application, i.e., "Specification 21 pages; Drawings 4 Sheets."

In regard to the handling of postcards and the items filed therewith, M.P.E.P. § 503 requires:

> The person receiving the item(s) in the USPTO will
> check the listing on the postcard against the item(s) being filed
> to be sure that they are properly identified and that all the items
> listed on the postcard are presently being submitted to the
> USPTO. If any of the items listed on the postcard are not being
> submitted to the USPTO, those items will be crossed off and
> the postcard initialed by the person receiving the items.

Since the item listed as "Specification 21 Pages" is not crossed off or altered on the returned postcard, Applicant respectfully submits that the parent application, i.e., the entire specification including page 7 alleged as being missing, was indeed among the papers originally filed by Applicant on March 9, 2004. Accordingly, since the PTO has apparently misplaced page 7 of the specification since the date of its receipt, Applicant hereby provides an additional copy of the parent application (including the misplaced page 7) in the attachment labeled as Exhibit 2.

In view of the above, Applicant respectfully requests that the USPTO find that the entire specification (including page 7) was originally submitted with the continuing application filed on March 9, 2004, and that the PTO misplaced page 7 of the specification.

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Accordingly, Applicant respectfully requests acceptance of the replacement specification (including page 7) filed herewith. Applicant further respectfully requests that the USPTO accept the previously filed copy of the Declaration from the parent application and accord the present application a filing date of March 9, 2004.

It is not believed that any fees are required for filing this Petition due to the mistake being on the part of the PTO. However, the Commissioner is hereby authorized to charge Deposit Account No. 06-1315; Order No. COMP:0208-1 for any fees which may be required. Furthermore, because the above-identified application is entitled to a filing date of March 9, 2004, Applicant hereby requests a refund of any petition fee that may be charged for the consideration of this petition upon a finding that: (1) Applicant originally submitted the entire specification including page 7 on March 9, 2004; (2) the PTO subsequently misplaced page 7 of the specification; and (3) the submission of this petition and a copy of the lost page 7 of the specification entitles the above-referenced application to a filing date of March 9, 2004.

If it is believed that a telephonic interview will help speed this application toward issuance, please contact the undersigned at the telephone number below.

Respectfully submitted,

Date: February 18, 2005
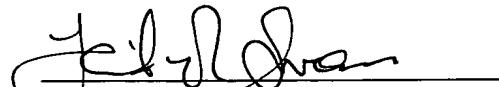
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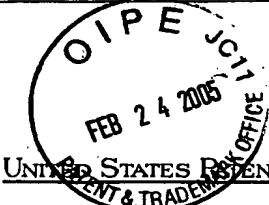
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APPLICATION NUMBER	FILING OR 371 (c) DATE	FIRST NAMED APPLICANT	ATTORNEY DOCKET NUMBER
10/796,627	03/09/2004	Paul James Broyles	200301870-2

HEWLETT-PACKARD COMPANY
Intellectual Property Administration
P. O. Box 272400
Fort Collins, CO 80527-2400

CONFIRMATION NO. 2781
FORMALITIES LETTER

OC000000015008420

Date Mailed: 01/24/2005

NOTICE OF OMITTED ITEM(S) IN A NONPROVISIONAL APPLICATION

FILED UNDER 37 CFR 1.53(b)

A filing date has been accorded to the above-identified nonprovisional application papers; however, the following item(s) appear to have been omitted from the application:

- Page(s) **7** of the specification (description and claims).

I. Should applicant contend that the above-noted omitted item(s) was in fact deposited in the U.S. Patent and Trademark Office (USPTO) with the nonprovisional application papers, a copy of this Notice and a petition (and $130.00 petition fee *(37 CFR 1.17(h))*) with evidence of such deposit **must** be filed within **TWO MONTHS** of the date of this Notice. The petition fee will be refunded if is determined that the item(s) was received by the USPTO.

II. Should applicant desire to supply the omitted item(s) and accept the date that such omitted item(s) was filed in the USPTO as the filing date of the above-identified application, a copy of this Notice, the omitted item(s) (with a supplemental oath or declaration in compliance with 37 CFR 1.63 and 1.64 referring to such items), and a petition under 37 CFR 1.182 (with the $130.00 petition fee *(37 CFR 1.17(h))* requesting the later filing date **must** be filed within **TWO MONTHS** of the date of this Notice.

Applicant is advised that generally the filing fee required for an application is the filing fee in effect on the filing date accorded the application and that payment of the requisite basic filing fee on a date later than the filing date of the application requires payment of a surcharge (37 CFR 1.16(e)). To avoid processing delays and payment of a surcharge, applicant should submit any balance due for the requisite filing fee based on the later filing date being requested when submitting the omitted items(s) and the petition (and petition fee) requesting the later filing date.

III. The failure to file a petition (and petition fee) under the above options (I) or (II) within **TWO MONTHS** of the date of this Notice (37 CFR 1.181(f)) will be treated as a constructive acceptance by the applicant of the application as deposited in the USPTO. **THIS TWO MONTH PERIOD IS NOT EXTENDABLE UNDER 37 CFR 1.136(a) or (b)**. In the absence of a timely filed petition in reply to this Notice, the application will maintain a filing date as of the date of deposit of the application papers in the USPTO, and original application papers (*i.e.*, the original disclosure of the invention) will include only those application papers present in the USPTO on the date of deposit.

In the event that applicant elects not to take action pursuant to options (I) or (II) above (thereby constructively electing option (III)), amendment of the specification to renumber the pages consecutively and cancel incomplete sentences caused by any omitted page(s), and/or amendment of the specification to cancel all references to any omitted drawing(s), relabel the drawing figures to be numbered consecutively (if necessary), and correct the

references in the specification to the drawing figures to correspond with any relabeled drawing figures, is required. A copy of the drawing figures showing the proposed changes in red ink should accompany with any drawing changes . Such amendment and/or correction to the drawing figures, if necessary, should be by way of preliminary amendment submitted prior to the first Office action to avoid delays in the prosecution of the application.

Replies should be mailed to: Mail Stop Missing Parts

Commissioner for Patents

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A copy of this notice MUST be returned with the reply.

Customer Service Center
Initial Patent Examination Division (703) 308-1202
PART 2 - COPY TO BE RETURNED WITH RESPONSE

Please indicate receipt of
the below-identified paper:

☒ New Application ☒ Specification: 21 Pages; Drawings: 4 Sheets

☒ Continuation ☐ Divisional ☐ CIP ☐ CPA

☐ Response to Office Action dated _____ ☐ Final Rejection
☒ Other _____ Preliminary Amendment, Information Disclosure Statement, PTO Form
1449, Request for a Continuing Application under 37 CFR 1.53(b); Declaration; Notice of
Recordation of Assignment; postcards (2)

☒ Assignment enclosed ☐ Cert. Of Timely Mailing ☒ Express Mail

Identification of Application:
Serial No. _____ Unassigned
Title _____ Dynamic Allocation Of Devices To Host Controllers

Applicant _____ Paul James Broyles
Client _____ Hewlett-Packard Development Company
File No. 200301870-2 (COMP:0208-1/FLE/SWA) Attorney FLE/SWA
Mailed 03/09/2004 Filed _____ Due Date _____

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Applicant _____ Paul James Broyles
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File No. 200301870-2 (COMP:0208-1/FLE/SWA) Attorney FLE/SWA
Mailed 03/09/2004 Filed _____ Due Date _____

17858 U.S. PTO
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Please indicate receipt of
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☒ New Application ☒ Specification: 21 Pages; Drawings: 4 Sheets

☒ Continuation ☐ Divisional ☐ CIP ☐ CPA

☐ Response to Office Action dated _____ ☐ Final Rejection
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Title _____ Dynamic Allocation Of Devices To Host Controllers

Applicant _____ Paul James Broyles
Client _____ Hewlett-Packard Development Company
File No. 200301870-2 (COMP:0208-1/FLE/SWA) Attorney FLE/SWA
Mailed 03/09/2004 Filed _____ Due Date _____

DYNAMIC ALLOCATION OF DEVICES TO HOST CONTROLLERS

By:

Paul J. Broyles
Cypress, Texas
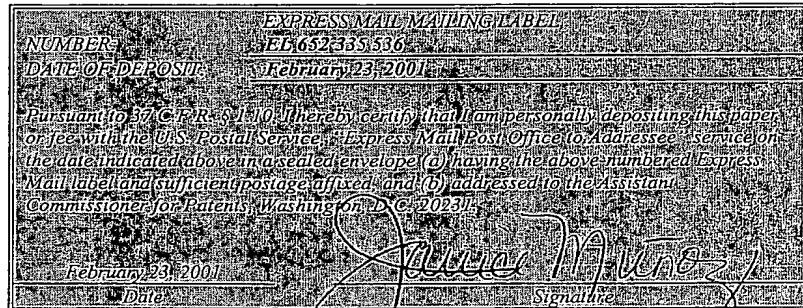
DYNAMIC ALLOCATION OF DEVICES TO HOST CONTROLLERS

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Field Of The Invention

The present technique relates generally to the field of computer systems, and more specifically, to control systems for the computer systems. The present technique is a system and method for routing devices to controllers based on data transfer capacities of

10 the controllers and data transfer specifications of the devices.

Background of the Invention

Computer systems (e.g., desktops, laptops, servers, workstations, PDAs, etc.) generally comprise a plurality of components, such as memory, a display, a modem, a

15 processor and/or a controller unit, which are integrated for a particular application. The components communicate through a bus, or collection of conductors, which comprises an address bus for identifying the components and a data bus for transferring data between the components. Moreover, computer systems often have multiple bus types, such as a local bus and an expansion bus (e.g., for add on components), each having an address and data

20 bus. Computer systems also comprise many different bus architectures, such as ISA/AT (Industry Standard Architecture), EISA (Extended ISA), PCI (Peripheral Component Interconnect), VESA, and USB (Universal Serial Bus), which may have substantially different data transfer characteristics (e.g., clock speed and data bandwidth). Clock speed refers to the speed at which data is transferred, while data bandwidth refers to the amount of

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data that is transferred per transmittal. A local bus (e.g., PCI) connects almost directly to the processor, providing very fast throughput versus an expansion bus (e.g., AT). For example, an AT bus may run at 8 megahertz with a 16-bit bandwidth, while a PCI bus may operate at 33 or 66 megahertz with a 64-bit bandwidth.

5

Controllers utilize the buses and control the transfer of data among components of the computer system. For many devices, the local bus is desirable to ensure sufficient data transfer speed and bandwidth. Unfortunately, the components often outnumber the available controllers due to various cost restraints, space limitations, and other

10   considerations. For example, an ASIC chipset (Application Specific Integrated Circuit) often has 2 host controllers for 4 or 6 ports and/or devices.

As mentioned above, the buses and controllers have limited data transfer capacities (i.e., speeds and bandwidths), which may depend on the particular architecture of the

15   computer system. In contrast, devices have widely varying data transfer requirements, which may be substantially more demanding for some devices. For example, devices such as digital cameras and DVD-ROM drives typically require greater bandwidth than devices such as keyboards or pointer devices. A camera may require 70-80% of the available bandwidth, whereas a keyboard or mouse may require only 5-10% bandwidth. If two

20   cameras are connected to a single controller, there may be a bottleneck if the controller does not have enough bandwidth for both of the cameras. Accordingly, the bottleneck may cause system or device failures, conflicts and/or other performance problems.

Currently, bandwidth utilization is maximized by intelligently attaching devices to the controllers. In many computer systems, the controllers are hardwired to a predetermined number of devices or ports (internal or external), preventing any reconfiguration other than by rearranging the devices. Accordingly, configuring the devices

5   and components requires uncommon knowledge of board/chip design and device requirements, as well as time for the configuration. As computer technology continues to advance, computer systems are often upgraded by adding or replacing components. For example, a DVD-ROM drive or a digital camera may be added to an existing computer system. Unfortunately, a consumer generally lacks the computer expertise (e.g., system

10   configurations, controller specifications, or device requirements) necessary to properly configure the devices to ensure sufficient data transfer rates for each of the devices. The typical consumer would tend to connect a newly purchased device to the first available port. Although this configuration may operate, it can cause device conflicts and/or performance problems if the connection results in insufficient bandwidth for one or more of the devices

15   coupled to the port.

One solution would be to add more host controllers, or a dedicated controller for high speed devices. However, adding controllers results in higher costs for the computer system. As consumers continue to demand lower priced computer systems, it is desirable to

20   keep the number of components and costs to a minimum. Furthermore, additional host controllers would not completely solve the problem, because each of the host controllers still has a limited amount of bandwidth for multiple devices.

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Accordingly, there is a need for an improved technique for routing devices to host

controllers to ensure that each device receives sufficient bandwidth and that each controller

is not overloaded beyond its available bandwidth. It would be advantageous to provide a

technique that would detect the bandwidth requirements for the devices, compare the

5   bandwidth requirements with the available bandwidths from each of the controllers, and

then distribute the devices to the controllers such that each device receives a desired

bandwidth.

SUMMARY OF THE INVENTION

10   The present technique is associated with a device-controller configuration system

for a computer system having a plurality of controllers. The technique utilizes an

automatic switching assembly to ensure that each device is routed to one of the

controllers based on a data transfer specification of the device and data transfer capacities

of the controllers. Accordingly, the technique evaluates at least one of a plurality of

15   hypothetical configurations to determine a viable and/or optimal configuration.

According to one aspect of the present technique, a system may be provided for

routing a device to a controller for a computer. The system may comprise a switchable

routing assembly configured for automatically routing each of a plurality of the devices to

20   one of a plurality of the controllers, wherein the switchable routing assembly is configured

to distribute available data transfer capabilities for each of the plurality of controllers to the

plurality of devices based on a desired data transfer statistic for each of the plurality of

devices.

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According to another aspect of the present technique, a method may be provided for automatically configuring a plurality of devices with a plurality of controllers for a computer system. The method may comprise obtaining a plurality of data transfer

5   specifications for the plurality of devices, determining a plurality of hypothetical configurations having each device coupled to one of the plurality of controllers, and comparing the plurality of data transfer specifications with data transfer capacities of each of the plurality of controllers for at least one of the hypothetical configurations. The technique also may comprise selecting a viable configuration from the plurality of

10   hypothetical configurations based on the comparison of data transfer specifications and data transfer capacities. Accordingly, each device may be automatically routed to one controller based on the selected viable configuration.

BRIEF DESCRIPTION OF THE DRAWINGS

15   The foregoing and other advantages of the invention will become apparent upon reading the following detailed description and upon reference to the drawings in which:

Figure 1 is a diagram of a controller system having a series of controllers with multiple ports and devices coupled to the ports;

20

Figure 2 is a diagram of the controller system having a device routing system for automatically routing each of the devices to one of the controllers;

5

Figure 3 is a diagram of the controller system illustrating devices being coupled to ports, which are coupled to the device routing system;

Figure 4 is a flow chart of the present technique, illustrating operation of the

5　device routing system; and

Figures 5 and 6 are diagrams of the controller system illustrating routing configurations before attachment of a device, and after attachment and operation of the device routing system, respectively.

10

DETAILED DESCRIPTION OF SPECIFIC EMBODIMENTS

The present technique comprises a system for routing a plurality of devices to one or more controller units based on data transfer characteristics of both the devices and the controllers. Figure 1 illustrates an example of an existing controller system 10A configured

15　for a computer system or other electronic device, wherein the controller system 10A has controllers #1 and #2, ports #1 through #4, and devices #1 through #4. As illustrated, a plurality of ports are wired to each of the controllers #1 and #2, and a device is wired to each of ports #1 through #4. For example, devices #1 and #2 are wired to ports #1 and #2, respectively, which are then wired to the controller #1. Similarly, devices #3 and #4 are

20　wired to ports #3 and #4, respectively, which are then wired to the controller #2. The wiring may be permanent, or removable to allow reconfiguration of the ports and/or devices, and may extend directly from the devices to the controllers rather than through a port as illustrated. Moreover, the ports may comprise a serial bus port, a parallel port, an

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infrared port, a universal serial bus (USB) port, and other ports for a variety of bus

architectures (e.g, ISA, USB, PCI, etc.).

In this exemplary embodiment, the controllers #1 and #2 provide data transfer

5   control for the devices #1-2 and #3-4, respectively, such as between a computer system and

a device for the computer system (e.g., a disk drive, a display screen, a keyboard, a printer, a

digital camera, etc.). Each of the controllers #1 and #2 has a data transfer capacity (e.g., an

available bandwidth) for transferring data between the computer system and the device,

while each of the devices #1 through #4 has a desired or required data transfer specification

10   (e.g., a desired bandwidth) necessary for optimal operation of the device. For example, the

devices #1 through #4 may require 50%, 20%, 12% and 70% of the available bandwidth,

respectively, which would not cause a problem or conflict with the available bandwidth.

However, the devices #1 through #4 may require 80%, 80%, 10% and 10%, respectively,

which would cause a substantial overload of the available bandwidth for controller #1. To

15   optimally operate in this controller system 10A, the devices #1 through #4 must be coupled

to the appropriate controller to ensure that each of the devices receives a sufficient amount

of the available bandwidth. Thus, in the second scenario, the devices #1 through #4 would

need to be reconfigured, such as by coupling devices #1 and #3 to controller #1 and by

coupling devices #2 and #4 to controller #2. This would load each of the controllers with

20   90% (e.g., 80% plus 10%) of the available bandwidth. Unfortunately, this reconfiguration

process must be done manually for the controller system 10A of Figure 1, and may be

difficult where the data transfer capacities and specifications are unknown.

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Figure 2 is a diagram of one exemplary controller system 10B according to the

present invention. Controller system 10B may be deployed in an electronic device 11, such

as a personal computer, server, workstation, PDA, etc. Controller system 10B has a device

routing system 12 for automatically routing each of the devices #1 through #4 to one of the

5   controllers #1 and #2 based on data transfer characteristics (e.g., bandwidths) of the

controllers and devices. As illustrated, the device routing system 12 comprises a switch

assembly 14 configured for switching each of the devices #1 through #4 between a

connection with the controllers #1 and #2, such that a plurality of device-controller

connections may be achieved by the switch assembly 14. The switch assembly 14 may

10   comprise a switch register, wherein each logic switch connects the respective device to

either the controller #1 or the controller #2. For example, the switch assembly may

comprise an 8 bit switch register, such as $D_8D_7D_6D_5D_4D_3D_2D_1$ (binary), wherein D_N refers to

the device #N and the switch register connects the device #N to controller #1 for $D_N = 0$ and

to controller #2 for $D_N = 1$, respectively. Moreover, the controller system 10B may

15   comprise a program, or other software 16, for operating the switch assembly 14. For

example, the software 16 may comprise software in ROM BIOS (Read Only Memory,

Basic Input Output System), a device driver, and/or other system software. In this

exemplary embodiment, the software 16 may be used to detect devices, to determine data

transfer characteristics (e.g., bandwidth specifications) for the devices #1 through #4 and for

20   the controllers #1 and #2, and to determine an acceptable and/or optimal configuration for

connecting the devices to the controllers to ensure that each device receives sufficient

bandwidth.

Figure 3 is a diagram of the controller system 10B, wherein devices #1 through #4 are being coupled to ports #1 through #4, in sequence, and the device routing system 12 is disposed between the ports #1 through #4 and the controllers #1 and #2 for automatically configuring connections between the devices/ports and controllers to

5   ensure adequate bandwidth for each of the devices. Note that the device routing system 12 may be intiated as each of the devices are sequentially connected to the respective ports, or alternatively, the device routing system 12 may be initiated after all of the desired devices #1 through #4 have been connected to the ports #1 through #4, respectively. Moreover, the device routing system 12 may be disposed internal to or

10   external to a computer system or electronic device, and may comprise a variety of port and device arrangements (e.g., internal, external, direct wiring, etc.). For example, a hard drive may be wired directly to the device routing system 12 or to one of the controllers, while an external port may be provided for coupling a peripheral device such as a digital camera. Furthermore, the bus architecture may comprise a USB bus, a PCI bus, an ISA

15   bus, and a variety of other local and/or external bus architectures.

In Figure 4 a flow chart is provided to illustrate an exemplary operation of the device routing system 12. Also, Figures 5 and 6 are diagrams illustrating controller system 10B before and after operation of the device routing system 12, respectively. The

20   exemplary technique is illustrated for a system having controllers #1 and #2 and ports #1 through #4 for a camera #1, a camera #2, a mouse 18 and a keyboard 20, respectively. However, a variety of other types of devices may be connected through parts #1-#4.

As illustrated in Figure 4, the present technique may comprise connecting a device to a port #2, such as connecting camera #2 to port #2, and then initiating the routing system (block 22, e.g., the device routing system 12). For example, in Figure 5, the ports #1 through #4 are coupled to the switch assembly 14, which is configured such

5   that the ports #1 and #2 are coupled to the controller #1 and the ports #3 and #4 are coupled to the controller #2. In this exemplary embodiment, the configuration illustrated in Figure 5 is a default configuration for the device routing system 12. Note also that camera #1 is coupled to controller #1 through port #1, and requires 95% of the available bandwidth from the controller #1. For controller #2, the mouse 18 requires 10% and the

10   keyboard 20 requires 7% of the available bandwidth. By coupling the camera #2 to port #2, this balance of required bandwidths versus available bandwidths is disturbed, requiring reconfiguration to ensure sufficient bandwidth for each of the devices. Accordingly, the present technique operates (block 24) to reconfigure the connections between the devices and the controllers.

15

The device routing system 12 then determines the number (N) of devices and number (M) of controllers present (block 26) in the controller system 10, and determine the number $(P = M^N)$ of possible routing configurations (RC) (block 28). As mentioned above, the software 16 may detect the devices and/or the controllers, and begin a routine

20   (block 30) for calculating the optimal configuration for the devices and controllers. For example, the software 16 can store the different possible routing configurations (RC), and then sequentially evaluate the viability of each individual configuration (RC_I). Accordingly, the device routing system 12 steps through each of the possible routing

configurations (RC_1), beginning by determining the bandwidth (block 32) of controller #1 (C_1) for the first routing configuration (RC_1). The device routing system 12 may then proceed to determine the number (DR) of devices routed to the controller #1 for the first routing configuration (block 34), and start a subroutine for each of the devices (D_K)

5   hypothetically routed to the controller #1.

Furthermore, the present technique determines the bandwidth (block 36) of each of the devices (D_K) by detecting the device bandwidth, as discussed above. The device routing system 12 then evaluates whether another device (D_K) is coupled to the controller

10   (block 38), and, if so, continues to the next device (block 40) to determine the bandwidth (block 36) of that device. This process continues until all of the device bandwidths have been determined by the device routing system 12.

The technique then determines the total bandwidth (block 42) of devices

15   hypothetically coupled to controller #1 for the first routing configuration (RC_1). The device routing system 12 then compares (block 44) the total bandwidth (block 42) with the controller bandwidth (block 32). If the total bandwidth (block 42) is greater than the bandwidth of controller #1, as determined above (block 32), then the device routing system compares (block 46) the number (I) of the current routing configuration (RC_1)

20   with the total number (P) of routing configurations (RC). If device routing system 12 has evaluated all of the possible routing configurations, and has found no configurations which ensure that the controller bandwidths are not exceeded by the device bandwidths, then the controller system may be set to a default (block 48) (e.g., as illustrated in Figure

11

5). Otherwise, the device routing system 12 may continue (block 50) to the next possible

routing configuration RC_I, returning to the previous act of determining the bandwidth

(block 32) of the controller C_J.

5   Accordingly, the present technique evaluates the number of devices routed to the

controller (block 34), determines the bandwidth of each device routed to the controller

(block 36), determines the total bandwidth of devices routed to the controller (block 42),

and compares the total of device bandwidths versus the controller bandwidth (block 44).

As described above, if the total device bandwidth exceeds the controller bandwidth, then

10   the present technique continues to the query (block 46). Otherwise, if the total device

bandwidth is less than the controller bandwidth, then the technique determines if there are

additional controllers to evaluate (block 50).

    If the current number (J) of the controller (CJ) being evaluated is not the last

15   controller, then the technique continues to the next controller (block 52) and returns to the

act of determining bandwidth (block 32) for evaluation of the next controller and devices

hypothetically coupled to that controller. Otherwise, if the current number (J) is equal to

the total number (M) of controllers for the hypothetical routing configuration being

evaluated, then the present technique has successfully determined a viable configuration

20   for the controllers and devices to ensure adequate bandwidth for each of the devices.

Accordingly, the device routing system 12 may proceed to set (block 54) the controller

system 10B to the routing configuration (RC_I) just evaluated above. This may comprise

transmitting switching instructions from the software 16 to the switch assembly 14, and

then configuring the controller to port/device connections via switch registers, as discussed above.

Thus, in this exemplary embodiment, the device routing system 12 sequentially evaluates possible routing configurations, and selects the first viable configuration for the devices and controllers. Alternatively, the present technique may evaluate all possible routing configurations, and select the routing configuration that provides an optimal distribution of available bandwidth from the controllers to the devices. Furthermore, the present technique may be utilized for any number of controllers, devices and/or ports, and may be applied to a variety of electronic systems having controllers and devices requiring access to those controllers. The present technique may also resolve configuration problems with controller systems 10B that do not have sufficient bandwidth in any controller-port/device configuration. For example, the device routing system 12 may determine the available bandwidths of the controllers #1 and #2, determine the desired device bandwidths of devices #1 through #4, determine ratios of the desired device bandwidths to the total available bandwidths, and then distribution the total available bandwidths to the devices #1 through #4 accordingly.

While the invention may be susceptible to various modifications and alternative forms, specific embodiments have been shown by way of example in the drawings and have been described in detail herein. However, it should be understood that the invention is not intended to be limited to the particular forms disclosed. For example, the present technique may be applied to a variety of electronic systems having multiple device

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controllers for a plurality of devices. The technique also may be utilized in a variety of

system architectures, and for a variety of resource allocations other than data transfer

characteristics of the devices and controllers. Accordingly, the invention is intended to

cover all modifications, equivalents, and alternatives falling within the spirit and scope of

5   the invention as defined by the following appended claims.

CLAIMS

What is claimed is:

1. A tangible medium, comprising:

5   code disposed on the tangible medium, wherein the code comprises:

analyzer code configured to determine a device bandwidth for the device and

to achieve a bandwidth evaluation of the device bandwidth versus first and second available

bandwidths of first and second controllers, respectively; and

router code configured to route the device to one of the first and second

10   controllers based on the bandwidth evaluation.

2. The tangible medium of claim 1, comprising ROM BIOS.

3. The tangible medium of claim 1, wherein the code is at least partially disposed in

15   a device driver.

4. The tangible medium of claim 1, wherein the code comprises device detection

code configured to detect the device.

20   5. The tangible medium of claim 1, wherein the code comprises controller

detection code configured to detect the first and second controllers.

6. The tangible medium of claim 1, wherein the analysis code is configured to evaluate viability of a plurality of device-controller configurations.

5   7. The tangible medium of claim 6, wherein the analysis code is configured to evaluate all possible device-controller configurations and to determine an optimal configuration based on the device bandwidth and the first and second available bandwidths.

8. A tangible medium, comprising:

10   code disposed on the tangible medium, wherein the code is configured to analyze a desired bandwidth of the device against available bandwidths of a plurality of controllers, to select one of the plurality of controllers for the device based on the analysis of the desired bandwidth against the available bandwidths, and to route the device automatically to the selected one of the plurality of controllers.

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9. The tangible medium of claim 8, wherein the code is configured to analyze desired bandwidths of multiple devices including the device against available bandwidths of the plurality of controllers and to select a routing configuration of the multiple devices to the plurality of controllers based on the analysis of the desired bandwidths against the

20   available bandwidths.

10. The tangible medium of claim 8, wherein the code is configured to detect the desired bandwidth for the device.

11. The tangible medium of claim 8, wherein the code is configured to detect the

5   available bandwidths for the plurality of controllers.

12. The tangible medium of claim 8, wherein the code is configured to activate a switch to couple the device to the selected one of the plurality of controllers.

10   13. The tangible medium of claim 8, wherein the code is configured to evaluate viability of a plurality of hypothetical configurations each having the device coupled to one of the plurality of controllers.

14. The tangible medium of claim 8, wherein the code is configured to determine

15   possible device-controller configurations, to evaluate at least one of the possible device-controller configurations, and to select one of the possible device-controller configurations that provides the desired bandwidth to the device.

15. The tangible medium of claim 8, wherein the code is configured to evaluate all

20   possible device-controller configurations and to select an optimal device-controller configuration based on the analysis of the desired bandwidth against available bandwidths.

16. A system for automatically routing a device to a controller, comprising:

means for analyzing a desired bandwidth of the device against available bandwidths

of a plurality of controllers; and

5 means for selecting one of the plurality of controllers for the device based on the

analysis of the desired bandwidth against the available bandwidths.

17. The system of claim 16, comprising means for automatically routing the device

to the selected one of the controllers.

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18. The system of claim 16, comprising means for determining the desired

bandwidth for the device.

19. The system of claim 16, comprising means for determining the available

15 bandwidths for the plurality of controllers.

20. A method of providing device-to-controller routing, comprising:

providing an analyzer mechanism configured for analyzing a desired bandwidth of a

device versus available bandwidths of device controllers; and

20 providing a router mechanism configured for routing the device to one of the device

controllers based on the analysis.

21. The method of claim 20, comprising providing a computer having the analyzer mechanism and the router mechanism.

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22. The method of claim 20, comprising providing a device controller having the analyzer mechanism and the router mechanism.

23. The method of claim 20, comprising providing a controller detection mechanism configured to detect characteristics of the device controllers.

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24. The method of claim 20, comprising providing a device detection mechanism configured to detect characteristics of the device.

25. The method of claim 20, wherein providing the routing mechanism comprises

15   providing a device-controller configuration mechanism configured to evaluate viability of a plurality of device-controller configurations between the device and the device controllers.

26. The method of claim 20, wherein providing the routing mechanism comprises providing an automatic switching mechanism configured to couple the device switchably to

20   the one of the device controllers based on the analysis.

ABSTRACT OF THE DISCLOSURE

The present technique is associated with a device-controller configuration system for a computer system having a plurality of controllers. The technique utilizes an automatic switching assembly so that each device is routed to one of the controllers based on a data transfer specification of the device and data transfer capacities of the controllers. Accordingly, the technique evaluates at least one of a plurality of hypothetical configurations to determi0ne a viable and/or optimal configuration.

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